Chromophoric dissolved and particulate organic matter cycling through a tidally influenced restored marsh ecosystem in Eastern North Carolina

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1. Introduction
- Fluorescence is an optical technique capable of discriminating between the chemical composition of chromophoric dissolved organic matter (CDOM)
- Organic matter can be continuously transformed between the dissolved (DOM) and particulate (POM) phases as it moves through a natural environment (e.g. a tidal marsh)

2. Hypothesis
- The marsh acts as a reactor for marine derived POM, converting it to DOM, and that these changes can be traced with absorption and fluorescence measurements

3. Objectives
- Analyze optical characteristics (e.g. indicative of origin and quality) of DOM and POM in a tidally influenced marsh
- Quantify temporal alterations to chemical composition using parallel factor analysis (PARAFAC)
- Capture daily and seasonal variations in the CDOM flux through continuous flow and fluorescence measurements
- Identify the role of this coastal restored marsh system to export DOC to a neighboring estuary

4. North River Farms Wetland Restoration Project - Site description
- One of two sampling houses
- ISCO autosampler
- Turner CDOM sensor
- Manta 2 EurekaTM

Dimensions:
- Tidal Creek through marsh: 700 meters
- Restored marsh encompassed with silt fence: 5.7 hectare

5. Method
- Field collections
  -ISCO automatic water samplers make hourly collections into 1-L bottles over a 24-hour period; Collections will occur once a month between April - September, 2011
  - Continuous measurements with a Manta 2 EurekaTM sensor with Turner designsTM probe and a Spectro::Lyzer probe
    - Conductivity, pH and DO
    - CDOM (C-region)
    - Absorption (UV - Visible)

- Laboratory Methods
  1. Retentate POM size fraction >0.7 μm for extraction
  2. Permeate size fraction <0.2 μm for CDOM

- Dissolve POM with 0.1 N NaOH for 24 hours
- Neutralize to pH 7-8 with 12 N HCl
- Filter solution with 0.22 μm filter

- Varian 300 UV-ViE
- Absorption and Eclipse Fluorescence Spectrophotometers

- Data analysis using a PARAFAC model
  - Multi-variate technique: Sum of EEMs (excitation spectra * emission spectra * intensity) + residuals
  - Aides in the identification of unique fluorophores in a DOM pool

6. Preliminary Results
- POM EEM - CDOM EEM
- A. How is the fluorescence of the POM fraction different from the CDOM fraction?
- B. First look at CDOM characteristic fluctuations over a 24-hour period, including two tidal cycles:

7. Acknowledgements
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8. Citation
Abstract

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Organic matter in natural waters can undergo rapid transformations between the particulate and the dissolved phase due to physical, chemical and biological processes. In a coastal North Carolina restored marsh, we are quantifying the optical changes of dissolved (DOM) and particulate organic matter (POM) on multiple tidal cycles. We hypothesize that the marsh acts as a reactor for marine derived POM, converting it to DOM, and that these changes can be traced with natural fluorescence. We anticipate that flooding tides bring predominantly marine-sourced POM into the marsh, with a percentage becoming quickly degraded to DOM, which is then exported out of the marsh. Further, we expect this exported DOM is indicative of its source, derived from either autochthonous or allochthonous DOM production, and unique from inflowing DOM. We anticipate that microbial and photochemical reactions occurring during inundation of tidal water also contribute to changes in chemical composition of organic matter exported from the marsh. Fluorescence excitation-emission matrices will be used in the identification of source and degradation state of organic matter.

Our research expands on prior research into the transfer of organic matter between the particulate and dissolved phase of resuspended sediments in natural waters. We demonstrate a new POM extraction method to measure the fluorescence of chromophores present in, and perhaps released from, marine- and marsh-derived particulates. This procedure will be compared to a time-series experiment to determine how closely the lab method mimics degradation of particulates in the marsh. By evaluating these lab results and the optics of the POM and DOM pools collected in situ, we will identify the sources and cycling of organic matter in this marsh. Thanks to continuous flow and DOC concentration measurements in and out of the marsh, DOM export loads will also be quantified into the receiving North Carolina estuary.